

III Technological Objective

III.1 New and Improved Methods to Reduce Losses Caused by Insects, Ticks, and Mites

4. Screwworm

A. Current Technology

The sterile male technique has been a highly successful method for control of the screwworm fly with eradication of the pest being accomplished in the Southeastern United States as well as on the Island of Puerto Rico. In the Southwestern United States, the technique has provided adequate protection for warm-blooded animals and man for the past 13 years. However, constant reinfestation from Mexico has allowed the screwworm to reinfest the United States each year. The concept of using the behavior of a pest to eliminate itself is one of the truly original ideas of the twentieth century and has been expressed in one of the most dramatic demonstrations of the value of science to civilization. No other entomological pest management program researched, developed, and executed by the U. S. Department of Agriculture has had the impact on the producer and consumer that the screwworm program has had!

However, during 1972, the program suffered a serious setback in that 96,625 cases were reported in Texas alone. There were undoubtedly more unreported cases. During this year, the United States signed an agreement with Mexico to extend the eradication

program to the Isthmus of Tehuantepec. During 1973 and 1974, the situation was again serious in South Texas. Some ranchers reported as much as 20% loss of herds. Effective control was not obtained until late season as a result of adverse weather. These outbreaks were related to high populations of the Gulf Coast Tick that provided large numbers of wounds. The number of cases for 1975 have already exceeded those for 1973 and 1974, and Gulf Coast Ticks have again been a problem. Therefore, the fact becomes apparent that the screwworm program has been extended to include Mexico at a time when results suggest that serious problems exist in our current program.

Potential causes of the reduced effectiveness are:

(1) Nutrition. The factory converted to a hydroponic diet shortly before the first outbreak in 1972. This diet has been used since that time. Sufficient data are not available to establish this medium as a good substitute for meat.

(2) Assortative Mating. The selection of an avoidance or recognition mechanism by wild flies over the last 12 years (resistance).

(3) Behavioral Isolation. Undetected changes in rearing and handling procedures that resulted in alteration of behavior sufficient to isolate the released population (preferential mating of factory x factory flies).

(4) Laboratory Adaptation of Strains. Factory strains may lose the ability to compete in the field through natural selection in the process of becoming adapted to factory production.

(5) Remating. Factory males may no longer be able to satisfy the wild females in copulation. Equally possible is the selection of wild fly populations that mate multiply.

(6) Ticks. Increased screwworm cases resulting from an increase in number of wounds caused by the Gulf Coast Tick.

(7) Quality Control. Inadequate control of quality in the rearing, packaging, or distribution phase that results in the release of non-competitive insects.

(8) Weather. Favorable weather which results in excessive survival of screwworm populations during the winter months.

(9) Changes in Practices. Ranchers have changed their practices with the result of more cattle, uncontrolled calving, absence of sufficient cowboys, etc.

B. Visualized Technology

With the 1972 outbreak, restaffing and funding has occurred at the Mission location. The primary objectives of this research can be viewed in 3 ways:

(1) An evaluation and identification of the factors involved in the recent reduced effectiveness of program-reared flies.

(2) The development of procedures or concepts that restore or improve overall program effectiveness.

(3) The investigation and study of the organism in the diverse terrain situation of Mexico and the integration of these findings into the action program.

C. Research Approaches

(1) Evaluation, identification, and solution of program problems.

(a) Monitor effectiveness of the APHIS Screwworm Eradication Program in the U. S. and Mexico. Ratios of wild to released flies will be determined with liver traps and sterility of egg masses determined.

(b) Evaluate the quality of flies produced on hydroponic and meat diets.

(c) Develop procedures to maintain quality of the factory flies. In this work, isoenzymes development rates as well as sensitivity to sound and sight will be used.

(d) Study behavior patterns of wild and factory flies. This research will be conducted to identify assortative mating or behavioral isolation, if it exists. Daily rhythms, response to temperature, photo period, etc., will be determined.

(2) Development of procedures or concepts.

(a) Develop new and improve the current trapping system. The development of a synthetic attractant will be

continued by screening chemicals commonly found in association with wounds. New trap designs and exposure systems will also be evaluated. Sex attraction will be studied for use in a trap.

(b) Find new sources of diet protein that offer price, supply, or biological advantages.

(c) Develop new and/or improve sterilization techniques. The current radiation dosage will be studied to determine if a reduction in dosage is possible. In addition, radiation in various gasses will be evaluated.

(d) Develop new colonies of flies for the Mexico and Texas program. Egg masses will be collected from geographic areas of Mexico and Texas and evaluated for inclusion in new strains.

(3) Investigate organism in Mexico.

(a) Study the ecology of the insect in Mexico and the U. S. The behavior of the fly in canyons and at different altitudes will be studied to determine release tactics and strain alterations necessary to insure insect performance.

(b) The possibility of biotypes in Mexico must receive considerable research because of physical isolation and terrain diversity. If it exists, procedures or strains must be developed for each situation.

(c) Determine the overall highest population and assist in the development of release tactics. This will be

determined by extensive trapping and observation in the various areas of Mexico. Research will continue to develop trapping systems capable of serving as an additional control procedure.

(d) Research unexpected or new problem areas as they develop.

D. Consequences of Visualized Technology.

To restore the program to earlier effectiveness and provide the new data necessary for a successful Mexico program.

E. Potential Benefits.

The benefits of this program from 1958 to 1974

(Data from APHIS) are shown below:

Year	Reduction in Losses and Costs	Cost of Program	Savings
1958	\$ 10,000,000	\$ 2,779,000	\$ 7,221,000
1959	20,000,000	5,141,000	14,859,000
1960	20,000,000	2,743,000	17,257,000
1961	20,000,000	1,257,000	18,743,000
1962	32,000,000	3,141,000	28,859,000
1963	52,000,000	5,863,000	46,137,000
1964	77,000,000	6,024,000	70,976,000
1965	94,000,000	5,148,000	88,852,000
1966	99,000,000	4,823,000	94,177,000
1967	119,000,000	5,568,000	113,432,000
1968	127,000,000	5,552,000	121,448,000
1969	135,000,000	7,431,000	127,569,000
1970	142,000,000	6,052,000	135,948,000
1971	147,000,000	7,152,000	139,848,000
1972	109,000,000	8,023,000	100,977,000
1973	164,000,000	11,438,000	152,562,000
1974	<u>195,000,000</u>	<u>12,175,000</u>	<u>182,825,000</u>
	\$1,562,000,000	\$100,310,000	\$1,461,690,000

Dr. Tom Prater (Agricultural Economist, Texas A&M University) and Dr. John Goodwin (Oklahoma State Department of Agriculture) have conducted studies on the cost-benefit ratio of the screwworm program, which are shown below:

	<u>With Program</u>	<u>Without Program</u>
U. S. Population	209,448,200	209,448,200
Per Capita Beef Consumption	114.2 lb	116.0 lb
Retail Beef Prices (Carcass Wt Basis)	87.25¢/lb	81.75¢/lb
Per Capita Expenditure on Beef	\$99.64	\$94.83
Per Capita Savings resulting from the Program		\$4.81
Change in Per Capita Beef Consumption Resulting from the Program		+1.8 lb
Total Retain Expenditures on Beef	\$20,869,418,648	\$19,861,972,806
Total Consumer Savings Resulting from the Screwworm Eradication Program		\$1,007,445,842
Maximum Annual Treasury cost of the Program (Fiscal 1973)		\$8,899,605
Cost-Benefits Ration		1:113

These data show 1.8 more pounds of beef per person were available annually to the nation as the result of the program. In addition, they show a per capita savings of \$4.81 and a cost-benefit ratio of 1:113. A later study by Dr. Edward Uvacek, Jr., Livestock Marketing Specialist at Texas A&M University, showed the cost-benefit ratio 1:39. His study indicated that the demand for beef is becoming more elastic, yielding a closer relationship between consumption change and price change.

It is obvious that the eradication program is of considerable worth to the producer and the consumer. As a result of the program, the producer can raise beef and other livestock more cheaply and reliably, which ultimately should be reflected in the price of the product to the consumer. From another point of view, if the program were discontinued or became ineffective, the presence of screwworms would cause a substantial cost to producers who would have to resort to using more insecticides (treating wounds), constructing fences, hiring labor, etc. These costs could cause many producers to go broke or leave the ranching business because of the limited or non-existent profit in the sales of livestock at this time.

It is much more difficult to assess the impact of ARS research on the efficiency and effectiveness of the program. Although all research may ultimately provide a basis for improved technology in the program, of special note are the following accomplishments:

(1) the development of a diet for mass rearing screwworms that consisted of gross foodstuffs such as dried whole blood, calf suckle, cottage cheese, and other ingredients that could be substituted for the standard meat diet; (2) the development of a chemical mixture that attracted screwworm flies which was more specific and more consistent in catches than the standard liver-baited traps; (3) establishing of specific strains of Mexican screwworm flies to replace the older, laboratory-reared strains that originated in Florida. All of these research discoveries (and many others) have been utilized by the APHIS program. The most important impact of the program has been on the minds of scientists. It was the first and only demonstration within the memory of most contemporary scientists that an insect population can be totally eliminated from a vast geographic area and also that an insect population can be managed at very low levels over a vast area by the uniform application of suppressive measures. The program demonstrated that methods can be devised to deal with major pests which are absolutely species specific and which do not kill many beneficial organisms and disrupt the ecology of agricultural regions. This program has led to increased appropriations for research to find new acceptable ways for dealing with pests. In addition, this program demonstrates that the maintenance of a 1400-mile border plus the eradication from Mexico is possible. This program defies the imagination of most pest management people.

F. Research Effort

Currently 7 SY's are at Mission with a budget of \$435,200. The APHIS budget for Mexico and the United States exceeds 20 million. Based on current problems and the expanded program, ARS will not be able to adequately meet the research needs of the APHIS program. Three additional SY's are needed at Mission to support the expanded Mexico program (\$173,000). Their work will include studies on insect competitiveness, trapping, attraction, ecology, and developing release tactics. These personnel should not be placed at Tuxtla Gutierrez until the Mission facility is closed to gain maximum advantage from research dollars. Reasons for this conclusion are:

(1) For monetary reasons: The operational costs for scientists in Mexico are greater than in the United States. Dr. Meyer, Director of the APHIS program, says it costs him around \$40,000 to get each person to Mexico (6 months' Spanish training, per diem, moving expenses). After arrival, housing allowance, schooling costs, and home leave effectively elevate the annual cost about \$15,000/person.

(2) Nature of the research: Most of the needed research in Mexico is ecological, and travel will be necessary regardless of the base location. The area needing maximum effort is around Poza Rica, about 500 miles from Mission and 600 miles from Tuxtla Gutierrez. We have recently purchased a 24-foot camper because of

the need for research in isolated areas of Mexico. In addition, more commercial travel routes are available in the Mission area than from Tuxtla Gutierrez.

(3) Logistics: Much of the equipment we use in research is specialized and repairs and service will be expensive or impossible to obtain in Tuxtla Gutierrez. Also, communication with the scientific community will be difficult. Currently, we have research relationships with Texas A&M, The University of Texas, Metabolism Laboratory at Fargo, Attractants Laboratory at Gainesville, and NASA. Their input will be easier to coordinate from our Mission location. In addition, qualified support personnel are difficult to hire in Tuxtla Gutierrez.

(4) Type of Work at Tuxtla Gutierrez: Most of the problems at the factory will be operational and directly involved with production. Distribution and handling problems will be equally great at the distribution centers. The Methods Development Sections from Tuxtla Gutierrez and Mission can best handle these problems.

